

Android GPUImage

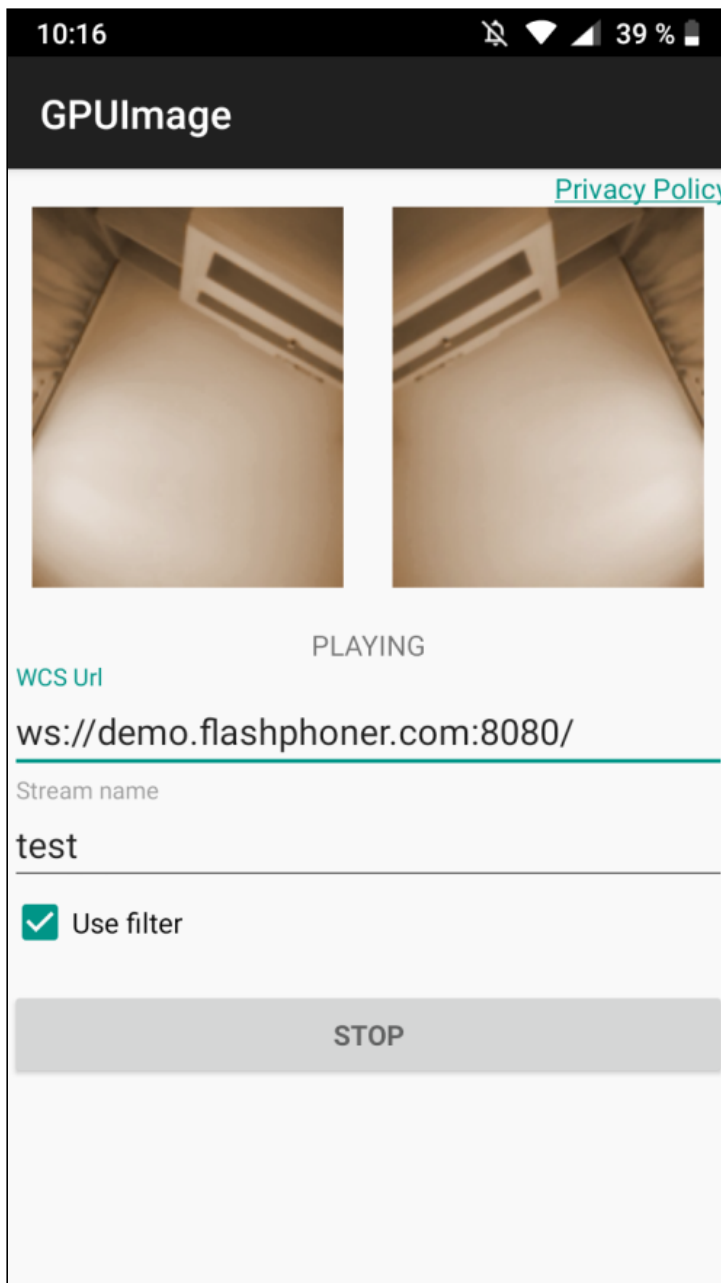
GPUImage library integration example to apply filters to a publishing stream

This example shows how to integrate the GPUImage library to the application for applying filters to the image while publishing a WebRTC stream. To do this, [video capturing from custom software source feature](#) is used. This example works with Android SDK builds since [1.1.0.27](#).

On the screenshot below, the sepia filter enabled is shown

Input fields:

- `WCS Url` - WCS server address for Websocket connection
- `Stream name` - stream name to publish and play
- `Use filter` - checkbox to enable or disable the filter



Analyzing the example code

To analyze the code, take the following classes of `gpu-image` example, which is available to download in build [1.1.0.27](#):

- main application activity class [GPUImageActivity.java](#)
- `Camera1Capturer` interface implementation class [GPUImageCameraCapturer.java](#)
- `Camera1Enumerator` interface implementation class [GPUImageCameraEnumerator.java](#)
- `CameraSession` interface implementation class [GPUImageCameraSession.java](#)

Note that interfaces implementation classes are placed to `org.webrtc` package, it is necessary to access camera capturing and management functions.

1. API initializing

`Flashphoner.init()` [code](#)

```
Flashphoner.init(this);
```

2. Websocket session creation

`Flashphoner.createSession()` [code](#)

The `SessionOptions` object with the following parameters is passing to the method:

- URL of WCS server
- `SurfaceViewRenderer localRenderer` to use to display a stream published (after filter applying)
- `SurfaceViewRenderer remoteRenderer` to use to display the stream playback

```
sessionOptions = new SessionOptions(mWcsUrlView.getText().toString());
sessionOptions.setLocalRenderer(localRender);
sessionOptions.setRemoteRenderer(remoteRender);

/**
 * Session for connection to WCS server is created with method
 * createSession().
 */
session = Flashphoner.createSession(sessionOptions);
```

3. Connection establishing

`Session.connect()` [code](#)

```
session.connect(new Connection());
```

4. Receiving the event confirming successful connection

`session.onConnected()` [code](#)

```
@Override
public void onConnected(final Connection connection) {
    runOnUiThread(new Runnable() {
        @Override
        public void run() {
            mStatusView.setText(connection.getStatus());
        }
    });
}
```

```

        ...
    }
});
};

```

5. Stream creation

`Session.createStream()` code

```

StreamOptions streamOptions = new StreamOptions(streamName);
Constraints constraints = new Constraints(true, true);
streamOptions.setConstraints(constraints);

/**
 * Stream is created with method Session.createStream().
 */
publishStream = session.createStream(streamOptions);

```

6. Permissions requesting

`ActivityCompat.requestPermissions()` code

```

@Override
public void onConnected(final Connection connection) {
    runOnUiThread(new Runnable() {
        @Override
        public void run() {
            ...
            ActivityCompat.requestPermissions(StreamingMinActivity.this,
                new String[]{Manifest.permission.RECORD_AUDIO,
                Manifest.permission.CAMERA},
                PUBLISH_REQUEST_CODE);
            ...
        }
    });
};

```

7. Stream publishing after permissions are granted

`Stream.publish()` code

```

@Override
public void onRequestPermissionsResult(int requestCode,
    @NonNull String permissions[],
    @NonNull int[] grantResults) {
    switch (requestCode) {
        case PUBLISH_REQUEST_CODE: {
            if (grantResults.length == 0 ||
                grantResults[0] != PackageManager.PERMISSION_GRANTED ||
                grantResults[1] != PackageManager.PERMISSION_GRANTED) {

```

```

        muteButton();
        session.disconnect();
        Log.i(TAG, "Permission has been denied by user");
    } else {
        /**
         * Method Stream.publish() is called to publish stream.
         */
        publishStream.publish();
        Log.i(TAG, "Permission has been granted by user");
    }
    break;
}
...
}
}
}

```

8. Stream playback after successful stream publishing

`Session.createStream()`, `Stream.play()` code

```

publishStream.on(new StreamStatusEvent() {
    @Override
    public void onStreamStatus(final Stream stream, final StreamStatus
streamStatus) {
        runOnUiThread(new Runnable() {
            @Override
            public void run() {
                if (StreamStatus.PUBLISHING.equals(streamStatus)) {

                    /**
                     * The options for the stream to play are set.
                     * The stream name is passed when StreamOptions object is
created.
                     */
                    StreamOptions streamOptions = new
StreamOptions(streamName);
                    streamOptions.setConstraints(new Constraints(true,
true));

                    /**
                     * Stream is created with method Session.createStream().
                     */
                    playStream = session.createStream(streamOptions);
                    ...
                    /**
                     * Method Stream.play() is called to start playback of
the stream.
                     */
                    playStream.play();
                } else {
                    Log.e(TAG, "Can not publish stream " + stream.getName() +
" " + streamStatus);
                    onStoped();
                }
                mStatusView.setText(streamStatus.toString());
            }
        });
    }
});

```

```
    }  
    });  
}  
});
```

9. Close connection

`Session.disconnect()` code

```
mStartButton.setOnClickListener(new OnClickListener() {  
    @Override  
    public void onClick(View view) {  
        muteButton();  
        if (mStartButton.getTag() == null ||  
Integer.valueOf(R.string.action_start).equals(mStartButton.getTag())) {  
            ...  
        } else {  
            /**  
             * Connection to WCS server is closed with method  
Session.disconnect().  
            */  
            session.disconnect();  
        }  
        ...  
    }  
});
```

10. Receiving the event confirming disconnection

`Session.onDisconnection()` code

```
@Override  
public void onDisconnection(final Connection connection) {  
    runOnUiThread(new Runnable() {  
        @Override  
        public void run() {  
            mStatusView.setText(connection.getStatus());  
            mStatusView.setText(connection.getStatus());  
            onStoped();  
        }  
    });  
}
```

11. `CustomCameraCapturerOptions` preparation

code

```
private CustomCameraCapturerOptions createCustomCameraCapturerOptions() {  
    return new CustomCameraCapturerOptions() {  
  
        private String cameraName;
```

```

private CameraVideoCapturer.CameraEventHandler eventsHandler;
private boolean captureToTexture;

@Override
public Class<?>[] getCameraConstructorArgsTypes() {
    return new Class<?>[]{String.class,
CameraVideoCapturer.CameraEventHandler.class, boolean.class};
}

@Override
public Object[] getCameraConstructorArgs() {
    return new Object[]{cameraName, eventsHandler, captureToTexture};
}

@Override
public void setCameraName(String cameraName) {
    this.cameraName = cameraName;
}

@Override
public void setEventsHandler(CameraVideoCapturer.CameraEventHandler
eventsHandler) {
    this.eventsHandler = eventsHandler;
}

@Override
public void setCaptureToTexture(boolean captureToTexture) {
    this.captureToTexture = captureToTexture;
}

@Override
public String getCameraClassName() {
    return "org.webrtc.GPUImageCameraCapturer";
}

@Override
public Class<?>[] getEnumeratorConstructorArgsTypes() {
    return new Class[0];
}

@Override
public Object[] getEnumeratorConstructorArgs() {
    return new Object[0];
}

@Override
public String getEnumeratorClassName() {
    return "org.webrtc.GPUImageCameraEnumerator";
}
};
}

```

12. Custom camera choosing before publishing

[code](#)

```
CameraCapturerFactory.getInstance().setCustomCameraCapturerOptions(createCustomC
CameraCapturerFactory.getInstance().setCameraType(CameraCapturerFactory.CameraTy
```

13. Enabling/disabling filter

code

```
mUseFilter = (CheckBox) findViewById(R.id.use_filter);
mUseFilter.setOnCheckedChangeListener(new
CompoundButton.OnCheckedChangeListener() {
    @Override
    public void onCheckedChanged(CompoundButton buttonView, boolean
isChecked) {
        GPUImageCameraSession.setUsedFilter(isChecked);
    }
});
GPUImageCameraSession.setUsedFilter(mUseFilter.isChecked());
```

14. Camera1Capturer interface implementation

code

```
public class GPUImageCameraCapturer extends Camera1Capturer {

    private GPUImageCameraSession cameraSession;
    private boolean captureToTexture;

    public GPUImageCameraCapturer(String cameraName, CameraEventsHandler
eventsHandler, boolean captureToTexture) {
        super(cameraName, eventsHandler, captureToTexture);
        this.captureToTexture = captureToTexture;
    }

    @Override
    protected void createCameraSession(CameraSession.CreateSessionCallback
createSessionCallback, CameraSession.Events events, Context
applicationContext, SurfaceTextureHelper surfaceTextureHelper, String
cameraName, int width, int height, int framerate) {
        CameraSession.CreateSessionCallback myCallback = new
CameraSession.CreateSessionCallback() {
            @Override
            public void onDone(CameraSession cameraSession) {
                GPUImageCameraCapturer.this.cameraSession =
(GPUImageCameraSession) cameraSession;
                createSessionCallback.onDone(cameraSession);
            }

            @Override
            public void onFailure(CameraSession.FailureType failureType,
String s) {
                createSessionCallback.onFailure(failureType, s);
            }
        };
        createCameraSession(myCallback, events, applicationContext, surfaceTextureHelper, cameraName, width, height, framerate);
    }
}
```



```

        }
    };

    GPUImageCameraSession.create(myCallback, events, captureToTexture,
applicationContext, surfaceTextureHelper,
Camera1Enumerator.getCameraIndex(cameraName), width, height, framerate);
    }
}

```

15. Camera1Enumerator implementation

code

```

public class GPUImageCameraEnumerator extends Camera1Enumerator {
    @Override
    public CameraVideoCapturer createCapturer(String deviceName,
CameraVideoCapturer.CameraEventsHandler eventsHandler) {
        return new GPUImageCameraCapturer(deviceName, eventsHandler, true);
    }
}

```

16. GPUImage packages import

code

```

import jp.co.cyberagent.android.gpuimage.GPUImage;
import jp.co.cyberagent.android.gpuimage.GPUImageRenderer;
import jp.co.cyberagent.android.gpuimage.PixelBuffer;
import jp.co.cyberagent.android.gpuimage.filter.GPUImageMonochromeFilter;
import jp.co.cyberagent.android.gpuimage.util.Rotation;

```

17. GPUImageCameraSession object initializing

code

```

public static void create(CreateSessionCallback callback, Events events,
boolean captureToTexture, Context applicationContext, SurfaceTextureHelper
surfaceTextureHelper, int cameraId, int width, int height, int framerate) {
    long constructionTimeNs = System.nanoTime();
    Logging.d("GPUImageCameraSession", "Open camera " + cameraId);
    events.onCameraOpening();

    Camera camera;
    try {
        camera = Camera.open(cameraId);
    } catch (RuntimeException var19) {
        callback.onFailure(FailureType.ERROR, var19.getMessage());
        return;
    }
}

```

```

    if (camera == null) {
        callback.onFailure(FailureType.ERROR, "android.hardware.Camera.open
returned null for camera id = " + cameraId);
    } else {
        try {

camera.setPreviewTexture(surfaceTextureHelper.getSurfaceTexture());
        } catch (RuntimeException | IOException var18) {
            camera.release();
            callback.onFailure(FailureType.ERROR, var18.getMessage());
            return;
        }

        Camera.CameraInfo info = new Camera.CameraInfo();
        Camera.getCameraInfo(cameraId, info);

        CameraEnumerationAndroid.CaptureFormat captureFormat;
        try {
            Camera.Parameters parameters = camera.getParameters();
            captureFormat = findClosestCaptureFormat(parameters, width,
height, framerate);
            Size pictureSize = findClosestPictureSize(parameters, width,
height);
            updateCameraParameters(camera, parameters, captureFormat,
pictureSize, captureToTexture);
        } catch (RuntimeException var17) {
            camera.release();
            callback.onFailure(FailureType.ERROR, var17.getMessage());
            return;
        }

        if (!captureToTexture) {
            int frameSize = captureFormat.frameSize();

            for(int i = 0; i < 3; ++i) {
                ByteBuffer buffer = ByteBuffer.allocateDirect(frameSize);
                camera.addCallbackBuffer(buffer.array());
            }
        }

        camera.setDisplayOrientation(0);
        callback.onDone(new GPUImageCameraSession(events, captureToTexture,
applicationContext, surfaceTextureHelper, cameraId, camera, info,
captureFormat, constructionTimeNs));
    }
}

```

18. Filter usage switching

code

```

public static void setUsedFilter(boolean usedFilter) {
    isUsedFilter = usedFilter;
}

```

19. Applying the filter

The filter is applied to the picture extracted from camera buffer, and data changed are returned back to the buffer

code

```
private void listenForByteBufferFrames() {
    this.camera.setPreviewCallbackWithBuffer(new Camera.PreviewCallback() {
        public void onPreviewFrame(byte[] data, Camera callbackCamera) {
            GPUImageCameraSession.this.checkIsOnCameraThread();
            if (callbackCamera != GPUImageCameraSession.this.camera) {
                ...
            } else if (GPUImageCameraSession.this.state !=
GPUImageCameraSession.SessionState.RUNNING) {
                ...
            } else {
                long captureTimeNs =
TimeUnit.MILLISECONDS.toNanos(SystemClock.elapsedRealtime());
                if (!GPUImageCameraSession.this.firstFrameReported) {
                    int startTimeMs =
(int)TimeUnit.NANOSECONDS.toMillis(System.nanoTime()) -
GPUImageCameraSession.this.constructionTimeNs);

GPUImageCameraSession.camera1StartTimeMsHistogram.addSample(startTimeMs);
                    GPUImageCameraSession.this.firstFrameReported = true;
                }

                applyFilter(data,
GPUImageCameraSession.this.captureFormat.width,
GPUImageCameraSession.this.captureFormat.height);

                VideoFrame.Buffer frameBuffer = new NV21Buffer(data,
GPUImageCameraSession.this.captureFormat.width,
GPUImageCameraSession.this.captureFormat.height, () -> {
                    GPUImageCameraSession.this.cameraThreadHandler.post(() ->
{
                        if (GPUImageCameraSession.this.state ==
GPUImageCameraSession.SessionState.RUNNING) {
GPUImageCameraSession.this.camera.addCallbackBuffer(data);
                        }
                    });
                });
                VideoFrame frame = new VideoFrame(frameBuffer,
GPUImageCameraSession.this.getFrameOrientation(), captureTimeNs);

GPUImageCameraSession.this.events.onFrameCaptured(GPUImageCameraSession.this,
frame);
                frame.release();
            }
        }
    });
}
```

20. Filter implementation

code

```
private void applyFilter(byte[] data, int width, int height) {
    if (!isUsedFilter) {
        return;
    }
    GPUImageMonochromeFilter filter = new GPUImageMonochromeFilter();
    filter.setColor(0,0,0);

    GPUImageRenderer renderer = new GPUImageRenderer(filter);
    renderer.setRotation(Rotation.NORMAL, false, false);
    renderer.setScaleType(GPUImage.ScaleType.CENTER_INSIDE);

    PixelBuffer buffer = new PixelBuffer(width, height);
    buffer.setRenderer(renderer);

    renderer.onPreviewFrame(data, width, height);
    Bitmap newBitmapRgb = buffer.getBitmap();
    byte[] dataYuv = Utils.getNV21(width, height, newBitmapRgb);
    System.arraycopy(dataYuv, 0, data, 0, dataYuv.length);

    filter.destroy();
    buffer.destroy();
}
```